

Appl. No. : 09/889,320
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AMENDMENTS TO THE SPECIFICATION

Please replace the Abstract with the following rewritten paragraph:

A hydraulic pump (100) driven in interlocked motion with a rear wheel, a front wheel driving hydraulic motor (101) connected to the hydraulic pump (100) and placed in the vicinity of a the front wheel (106), and a pressurizing means (102) interposed between the front wheel driving hydraulic motor (101) and the hydraulic pump (100) are provided, with the hydraulic pump (100), the front wheel driving hydraulic motor (101) and the pressurizing means (102) constituting a closed hydraulic circuit (103).

Please replace the "Disclosure of the Invention" section (i.e., pages 5-11 of the specification) with the following rewritten section:

To solve the above-described problems, a front and rear wheel drive type of vehicle of this invention comprises; a hydraulic pump driven as interlocked with the rear wheel, a hydraulic motor for driving the front wheel and disposed in the vicinity of the hydraulic pump, and a pressurizing means interconnecting the front wheel-driving hydraulic motor and the hydraulic pump; with the hydraulic pump, the front wheel-driving hydraulic motor, and the pressurizing means constituting a closed circuit.

According to the invention, since the pressurizing means pressurizes the working oil, cavitation does not occur even if the revolution of the hydraulic pump increases rapidly. Therefore, cavitation is prevented from occurring without providing a large reservoir for storing working oil.

In one embodiment, a-A front and rear wheel drive type of vehicle is provided, of claim 2 is based on the same of claim 1—wherein a pressurizing means is interposed between the suction side of the hydraulic pump and the discharge side of the hydraulic motor.

According to the invention, it is possible to pressurize the working oil on the low pressure side of the closed circuit.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided, of claim 3 is based on the same of claim 1—wherein the pressurizing means is interposed between the delivery side of the hydraulic pump and the suction side of the hydraulic motor.

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According to the invention, the constitution of the hydraulic circuit need not be changed whether the vehicle runs forward or reverse.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided, ~~of claim 4 is based on the same of claim 1~~ wherein the engine is used as the power source for the hydraulic pump.

According to the invention, a front and rear wheel drive type of vehicle can be easily produced by retrofitting the front wheel drive system components to an existing vehicle.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided, ~~of claim 5 is based on the same of claim 1~~ wherein an electric motor is used as the power source for the hydraulic pump.

According to the invention, since the front wheel can be driven by driving the hydraulic pump with the electric motor, variation in the hydraulic pressure can be held small and cavitation is less likely to occur.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided, ~~of claim 6 is based on the same of claim 1~~ wherein the hydraulic motor is constituted to be supplied with hydraulic pressure so that the hydraulic motor rotates synchronously with the front wheel in the running state of the front wheel rotating at a nearly equal rotary speed as that of the rear wheel.

According to the invention, drive force is not produced on the front wheel when the front and rear wheels are rotating at nearly equal rotary speeds even if the hydraulic motor is rotated with hydraulic pressure, and drive force is produced upon decrease in the drive force of the rear wheel as when the rear wheel spins.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided, ~~of claim 7 is based on the same of claim 1~~ wherein the hydraulic motor is constituted to be supplied with hydraulic pressure so that a drive force smaller than that on the rear wheel is produced on the front wheel in the running state of the front wheel rotating at a nearly equal rotary speed as that of the rear wheel.

According to the invention, a very small drive force is produced on the front wheel when the front and rear wheels are rotating at nearly equal rotary speeds and the drive force on the front wheel increases when the drive force of the rear wheel lowers as when the rear wheel spins.

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In another embodiment, a-A front and rear wheel drive type of vehicle is provided, ~~of claim 8 is based on the same of claim 1~~ wherein a run mode switching means is provided for switching between a run mode of running with the rear wheel only driven and a run mode of both the front and rear wheels driven.

According to the invention, all the power can be transmitted to the rear wheel by choosing the run mode of producing the drive force on the rear wheel only when running on a paved road or the like.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided, ~~of claim 9 is based on the same of claim 1~~ wherein a bladder made in a bag shape of rubber and filled with a high pressure gas is installed to a housing constituting part of the working oil passage to constitute a pressurizing means.

According to the invention, since the pressurizing means can be constituted with two components, the bladder and the housing, the constitution of the pressurizing means is simple.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided, ~~of claim 10 is based on the same of claim 1~~ wherein the pressurizing means is formed with a cylinder in which a high pressure gas chamber and a working oil chamber are defined with a free piston.

According to the invention, since the cylinder and the piston can be made of metal, the degree of freedom in setting the pressure is increased in comparison with the constitution using the bladder.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided, ~~of claim 11 is based on the same of claim 1~~ wherein the hydraulic circuit is constituted with; a pump unit having a hydraulic pump, a motor unit having a hydraulic motor, a hydraulic unit having a pressurizing means, an oil filter, and valves, with the oil filter attached to the housing of the hydraulic unit to form a single body, and with the valves attached to at least one of the three units to form a single body.

According to the invention, relatively small auxiliary components of the front wheel drive system such as the oil filter and the valves and relatively large components such as the hydraulic pump, hydraulic motor, and hydraulic unit can be made into units and mounted on the vehicle body. Therefore, it is possible to install all the components of the front wheel drive system in the

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vehicle body by mounting the three units, the pump unit, motor unit, and hydraulic unit on the vehicle body and interconnecting the units through piping.

In another embodiment, a front and rear wheel drive type of vehicle is provided,-of claim 12 is based on the same of claim 9 wherein the oil filter and the pressurizing means are placed side by side close to and longitudinally parallel to each other in the housing of the hydraulic unit, with a working oil inlet and a working oil outlet provided on the longitudinal end of the housing.

According to the invention, since piping can be laid parallel to the longitudinal direction of the hydraulic unit housing, the piping does not protrude extremely from the housing.

In another embodiment, a front and rear wheel drive type of vehicle is provided,-of claim 13 is based on the same of claim 12 wherein the working oil inlet and the working oil outlet are disposed on the end side of the oil filter, and a relief valve is disposed on the end side of the pressurizing means.

According to the invention, the piping and the relief valve can be interconnected utilizing a wide side wall formed on the longitudinal end of the housing in which relatively large-sized oil filter and pressurizing means are housed.

In another embodiment, a front and rear wheel drive type of vehicle is provided,-of claim 14 is based on the same of claim 1 wherein, the front wheel hub is formed in the shape of a bottomed cylinder having a cylindrical portion and a bottom portion so that the hub is formed with a cylindrical recess which is open to one side, the bottom portion is supported for rotation on a wheel shaft through a bearing, a disk-shaped cover for closing the cylindrical recess is secured to the wheel shaft, a hydraulic motor for driving the front wheel is supported with the cover and the output shaft of the hydraulic motor engages through gears with the hub within the cylindrical recess closed with the cover, the outside circumferential portion of the cover is positioned in the boundary portion between the cylindrical portion and the bottom portion, a labyrinth seal is formed between the outside circumferential portion of the cover and the cylindrical portion, and a seal member is interposed in a position between the outside circumferential portion of the cover and the hub and nearer to the bottom portion than the labyrinth seal.

According to the invention, since the seal member is in the deepest position from one side to the other of the hub, small stones and projections on the road do not directly strike the seal

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member. Moreover, since the labyrinth seal is formed outside the seal member, even if muddy water enters the cylindrical recess of the hub, the seal member is sealed with the labyrinth seal. Furthermore, since the seal member and the labyrinth seal are located in the deep position, and the end of the hub in the axial direction does not project sideways, the hub is made compact in the vehicle width direction.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided,-of claim 15 is based on the same of claim 14 wherein the gear engagement portion of the hydraulic motor and the hub is located close to the cover.

According to the invention, since the hydraulic motor can be supported near the gear engagement portion, the hydraulic motor can be supported firmly.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided,-of claim 16 is based on the same of claim 14 wherein the bearing for supporting the hub is constituted as a double row rolling bearing.

According to the invention, work of installing the hub on the wheel shaft becomes simple. Also, the boss of the hub through which the wheel shaft passes is made relatively short and so the weight of the hub is reduced.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided,-of claim 17 is based on the same of claim 1 wherein two, right and left front wheels are provided, each provided with a hydraulic motor for driving each wheel independently.

According to the invention, unlike the conventional front and rear wheel drive type of four-wheeled vehicle, drive shafts for driving the front wheels and a differential are unnecessary. Moreover, since each right or left front wheel is driven independently with each hydraulic motor, a differential-lock state can be easily established, making a complicated differential lock mechanism unnecessary.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided,-of claim 18 is based on the same of claim 17 wherein a hydraulic pump set comprises a hydraulic pump for driving the hydraulic motor for the left front wheel and a hydraulic pump for driving the hydraulic motor for the right front wheel, and working oil supply passages for supplying working oil from those hydraulic pumps to the respective hydraulic motors are provided independently on right and left sides.

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According to the invention, the front wheels on the right and left sides of the vehicle body are driven with hydraulic pressures respectively of separate hydraulic pumps.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided,-of claim 19 is based on the same of claim 17 wherein a single hydraulic pump is employed and a flow rate equally dividing means is interposed in the middle position on the working oil passage for supplying working oil from the hydraulic motor to hydraulic motors for the right and left front wheels.

According to the invention, since the single hydraulic pump can drive both of the right and left front wheels, the number of components is reduced, and a differential-lock state is easily established.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided,-of claim 20 is based on the same of claim 17 wherein working oil is returned from the hydraulic motors for the right and left front wheels through working oil recovery circuits to the hydraulic pumps, with part of the working oil recovery circuits is made for use in common for right and left, and with the common part provided with hydraulic auxiliary devices for use in common.

According to the invention, the hydraulic auxiliary device can be used in common for right and left sides while employing the constitution of driving the right and left front wheels with hydraulic pressure.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided,-of claim 21 is based on the same of claim 17 wherein an opening-closing valve for differential lock is provided for independently operating the hydraulic motors for the right and left front wheels.

According to the invention, with the differential lock opening-closing valve, the hydraulic motors for the right and left front wheels may be independently operated. This makes it possible, even in case one front wheel spins in the mud or the like, to continue running with the drive force of the other front wheel.

In another embodiment, a-A front and rear wheel drive type of vehicle is provided,-of claim 22 is based on the same of claim 1 wherein the engine power is transmitted through a mechanical transmitting means to the rear wheel to be driven.

A front and rear wheel drive type of four-wheeled vehicle of the invention may be realized by replacing only the structure of the front wheel drive system of conventional front and

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rear wheel drive type of vehicle or conventional small-sized four-wheeled vehicle with the structure of the hydraulic motor-driven type.